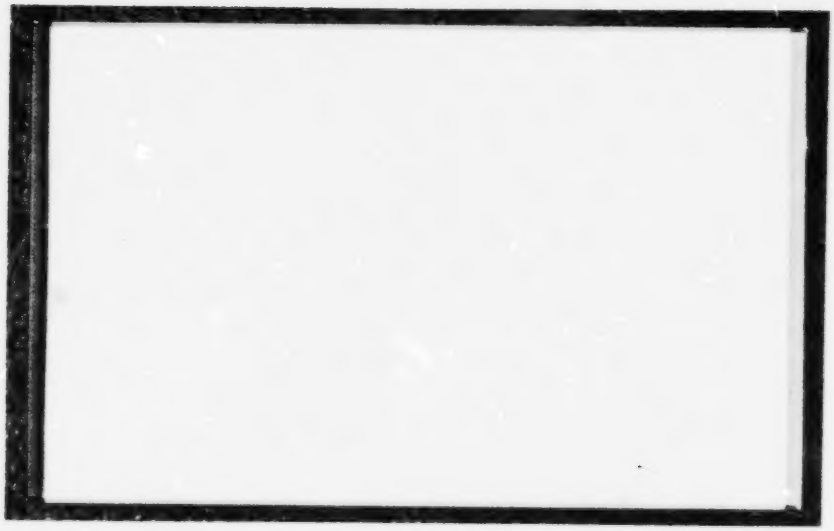
UNIVERSITÉ DE MONTRÉAL



CENTRE DE RECHERCHE SUR LES TRANSPORTS

CASE POSTALE 6128, SUCCURSALE A, MONTRÉAL, QUÉBEC, H3C 3J7

MORE ON GEOGRAPHICAL DISTRIBUTION OF PHYSICIANS AND MARKET FAILURE

by

Georges Dionne, Alain Langlois
and Nicole Lemire

The authors would like to thank M. Boyer, A.P. Contandriopoulos, J. Newhouse and F. Vaillancourt for their comments and F.C.A.C. (Québec) for financial support to this study.

Université de Montréal

Centre de recherche sur les transports - Publication #419
Département de sciences économiques - Cahier 8352

Septembre 1985

Dépôt légal - 4e trimestre 1985

ABSTRACT

In an important study published in 1982, Newhouse, Williams, Bennett et Schwartz (NWBS hereafter) analysed the geographical distribution of physicians using US data and emphasized that the physician's ability to create demand is neither necessary nor sufficient to yield a prediction of nondiffusion. The object of our paper is twofold. Firstly, we present a simple model in order to formalize the theoretical considerations of NWBS and to show under what conditions their conclusions are consistent with those predicted by the model. Secondly, we present an empirical analysis of the model using Probit procedure and data for the Province of Quebec. In conclusion, our results are summarized and policy implications are discussed.

RESUME

Dans un article important publié en 1982, Newhouse, Williams, Bennett et Schwartz (NWBS) ont analysé la distribution géographique des médecins américains et ont montré que la création de demande n'est pas une condition nécessaire ni suffisante pour prédire la non-diffusion des médecins. Dans ce cahier, nous présentons un modèle théorique permettant de formaliser les considérations théoriques de NWBS et de montrer les conditions sous lesquelles leurs prédictions théoriques sont vérifiées. De plus, nous présentons une analyse empirique de la distribution des médecins au Québec réalisée à l'aide du modèle Probit. En conclusion, nous résumons les principales contributions du cahier et nous discutons de leurs implications en terme de politique économique.

1. INTRODUCTION

The geographic distribution of physicians is characterized by the following features. 1) Despite the fact that many countries have enough doctors, many rural centers do not have sufficient number of doctors to meet the demand. In fact, many physicians prefer to practice in urban areas even with lower income. 2) Despite overcapacity in major urban centers and shortages in rural regions, the gap between urban and rural incomes is quite small. Two hypotheses are often put forth to explain this phenomenon : induced demand and patient mobility. 3) Furthermore the distribution problem is more acute for specialists than for general practitioners.

In an important study published in 1982, Newhouse, Williams, Bennett and Schwartz (NWBS hereafter) analyzed the geographical distribution of physicians using US data and emphasized that the physician's ability to create demand is neither necessary nor sufficient to yield a prediction of nondiffusion. Moreover, they concluded that the geographical allocation of physicians is consistent with the standard competitive model and that government intervention to alter geographic distribution cannot rest on arguments of market failure.

The object of this paper is twofold. Firstly, we present a simple model in order to extend the theoretical considerations of NWBS and to show under what conditions their conclusions are consistent with those predicted by the model. This model is also an extension of the

theoretical framework proposed by Dionne and Contandriopoulos (1985) in their review the Pauly's book (1980) on the economic behavior of physicians. Here we emphasize the decision about geographical area of practice, instead of the decision to use resources in the short-run (physician's own time and other inputs). Moreover, our analysis is limited to a given stock of physicians since we don't yet have data which permits us to analyze the effects of an increase in the stock of physicians. However a fairly straightforward analysis of the growth of physicians per capita can be made using the model.

Secondly, this paper presents an empirical analysis of the model using Probit procedure and data for the Province of Quebec. The results are consistant with standard location theory and therefore with those of NWBS. However, they also show that other factors have to be considered in order to take into account the particular features of the medical care industry. In conclusion, the results of the article are summarized and policy implications are discussed.

2. THE THEORETICAL MODEL

Many authors have contributed to the analysis of the economic behavior of doctors (see Pauly (1980) and Dionne and Contandriopoulos (1985) for a review). This section presents a model which extends the theoretical considerations of NWBS and allows for a prediction of doctor's choice of geographical area of practice. It also motivates the specification of the empirical model presented in the next section.

2.1. Maximization of net income

Let us assume for the moment that physicians maximize net income. They are price takers in the town where they decide to practice. However, they can modify their fees by moving from one city to another. According to this model, physicians have all the information in order to arrive at a decision. In other words, there is no uncertainty due to lack of information.

In order to simplify the presentation, we shall assume that there is only one major urban center (hereafter central city) in the country. In this way, it represents the departure point from which physicians must choose their geographic area of practice.

$Y(i)$ represents annual net income and is defined by :

(1) $$Y(i) = p(i)\, N(i) - C(N(i)) - a\, i$$

where

$N(i) = f(i)\, r(i)$ by definition, and

i is the distance between a particular city and the central city where $i = 0$. $i \in [0, I]$ and I is the upper limit of i. We assume that i is a continuous variable and affects continuously each variable which is a function of it. The signs of the derivatives with respect to i are established by the choice of the central city ($i = 0$).

$N(i)$ is the demand per physician.

$p(i)$ is the equilibrium price in cities with distance i. For notational convenience, $p(i)$ is written for $p(r(i))$ and p_i for $p_r r_i$.

$C(N(i))$ is an increasing and convex cost function $C_N > 0$, $C_{NN} > 0$.

a is the marginal and average cost of moving per unit of distance once practice is established. This is the cost of being away from the central city that the physician must undergo when he is established. Of course, a can be an increasing function of i. Here it is assumed constant in order to simplify the presentation.

$f(i)$ is the demand function for medical services of a typical individual in the country. By assumption, health status is not function of i. However the price of medical services net of insurance payments ($\pi(i) = (1 - \alpha)p(i)$ where α is the fraction of the cost paid by the insurer) is function of i. By assumption, income and other prices are not function of distance. Finally, insurance companies reimburse at market-clearing fees (for a discussion of non-market-clearing fees, see NWBS, 1982). For notational convenience, $f(i) \equiv f((1-\alpha)p(i))$.

$r(i)$ is the population/physician ratio in a city with distance i; $r_i > 0$, $r_{ii} > 0$ when the marginal cost of moving is greater than zero. Otherwise it is undeterminate. These equilibrium conditions can easily be verified empirically. They imply that equilibrium prices of medical services increase with i since equilibrium prices fall as supply curves shift to the right.

In this model the control variable is i. The marginal physician, knowing the preceding functions, chooses the optimal distance from the central city area when he decides his area of practice Therefore, the problem is to maximize (1) with respect to i which yields the following first order condition :

$$(2) \qquad N_i[p(i) - C_N] + N(i)p_i - a = 0$$

where $N_i = f_i r(i) + r_i f(i)$

$$f_i = f_\pi p_i (1 - \alpha)$$

Assume that i* is the unique solution and corresponds to a maximum. $\Delta < 0$ is the second order condition. This implies that for all $0 \leq i < i^*$, (2) is greater than zero for the marginal physician. In order to interpret the result, assume for the moment that p is regulated in the country at $\bar{p}$ and $p_i \equiv 0$. Therefore (2) is reduced to

$$(3) \qquad f(i)r_i[\bar{p} - C_N] - a = 0$$

which implies that $[\bar{p} - C_N] \geq 0$ as $a \geq 0$. When $a = 0$, the marginal physician chooses the town which permits him to equalize the marginal benefit to the marginal cost of attending patients. This solution is independent of r_i and of i since the marginal cost of moving is null. For all towns where $[\bar{p} - C_N] > 0$, which means that there is overcapacity, the marginal physician has an incentive to choose another city in order to increase his net revenue. In the long run, if the country has sufficient doctors, each

town having sufficient population (or demand) will have a physician independently of the distance from the central city. This solution corresponds to that obtained by NWBS from standard location theory. Now, if $a > 0$ and $r_i > 0$, the marginal physician will accept to set up his practice in a city with some overcapacity at the optimum. The optimal level of overcapacity is function of the marginal cost of moving and this cost reduces the dispersion of physicians for a given stock. In other words, cities around the central city area have a greater probability of attracting physicians and society requires a greater stock of physicians compared to the situation without cost of moving, in order to fill the needs of cities with sufficient demand. The high cost of moving explains why these cities may not have physicians at the optimum, despite overcapacity in the country at large. This important conclusion is obtained regardless of utility maximization and induced demand.

Now if $p_i > 0$, there are two more conflicting effects on the choice of optimal distance : a negative effect given by $f_i r(i)$ since demand decreases as price increases, and a positive effect given by $N(i)p_i$, since the equilibrium price increases with distance. Under full insurance coverage for medical services, the first effect is null since $f_i = 0$ and generally this effect is small under partial insurance coverage. Then N_i is generally positive but smaller than $f(i)r_i$. The second effect increases the mobility of physicians and will counteract the negative effect associated with the cost of moving, if $N(i)p_i \geq a$. Then, assuming that the market works properly, that physicians maximize net

income and that demand elasticity for medical care is low under insurance, then high moving costs can lead to overcapacity in some towns even when there is no overcapacity in the country at all. Furthermore, high moving costs can also explain why many cities do not have physicians even if there is enough demand.

Now, let us generalyze the cost of being away from the central city.

2.2. Maximization of utility

If physicians maximize utility as a function of income, leisure and prestige, the problem of choosing the optimal distance becomes:

$$\max_i U(Y(i), L(T(i), H(i)), \pi(HA(i)))$$

where

$Y(i)$	is defined by (1).
$T(i) = T - t\,N(i)$	is the leisure time.
$tN(i)$	is the work time.
t	is the average time used to attend a patient
T	is total time available.
$L(T(i), H(i))$	is a leisure index which is a function of $T(i)$, the time spent for leisure, and of $H(i)$, the quality of leisure. By definition, $L_{T(i)} > 0$, $L_{H(i)} > 0$ and $T_i = -tN_i$. By assumption, $H_i < 0$ for the average physician.
$\pi(HA(i))$	is prestige which is a function of a quality index of hospital affiliation (HA). $\pi_{HA} > 0$ and $HA_i < 0$ by assumption

The first order condition is

$$(4) \qquad N_i[p(i) - C_N] + N(i)p_i - a$$

$$+ \frac{U_L}{U_Y}\left(-L_{T(i)}{}^{t}N_i + L_{H(i)}{}^{H}{}_i\right) + \frac{U_\pi}{U_Y}\pi_{HA}{}^{HA}{}_i = 0$$

The last two terms are negative under the same conditions of the preceding section, and represent respectively a reduction of the marginal benefit to move from the central city area since the individual will have to work more ($-L_{T(i)}{}^{t}N_i$), will face a reduction in the quality of leisure ($L_{H(i)}{}^{H}{}_i$) and will reduce the possibility of affiliation to a prestigious hospital ($\pi_{HA}{}^{HA}{}_i$). The two terms have the same role as "a" in reducing the geographical mobility of physicians. Physicians, having such utility function, accept lower incomes in order to stay in attractive cities or to have the possibility of either conducting research or practicing in a reputable hospital.

2.3. Induced demand

According to Evans (1972), Sloan and Feldman (1978), Reinhard (1978), Pauly (1980) and NWBS (1982) demand creation requires excess supply. Based on Pauly (1980), traditional price-taker behavior is not consistent with demand shifting. This is also the case for the perfect agency relationship. Moreover, this behavior is not consistent with the real-income maximizing monopolist since "any observed availability effect must be due to changes in non-monetary rationing. If we are to

postulate a measurable availability effect from information, we must enlarge the set of arguments in the physician's utility function" (Pauly, 1980, p. 51).

Taking into account these considerations, the maximand becomes

(5) $U(Y(i), L(T(i), H(i)), \pi(HA(i)), E(D))$,

where E means ethical concern and is function of D, demand inducement ($U_E > 0$, $E_D < 0$). Now the physician has two control variables, i and E; he may decide to move from or to induce demand in the marginal city which he selects. Therefore, the problem is to maximize (5), subject to the same constraints of the problem in the preceding section, where N(i) is now equal to f(i, D)r(i). This yields, as first order conditions, condition (4) in the preceding section with the appropriate definition of f(i, D) and

(6) $$U_Y[p(i) - C_N]r(i)f_D - U_L L_{T(i)} r(i)t\, f_D + U_E\, E_D = 0.$$

Both conditions hold simultaneously. From (6), $D^* \geq 0$. If it is null, there is no effect on i^*. However when $D^* > 0$ this implies that $f(i, D) > f(i)$ for all i, and then higher N(i) and N_i in (4). It is clear that without further restrictions, the net effect on i^* is ambiguous. However, if we assume that $p_i \equiv 0$, and that N_i and $L_{T(i)}$ are constant, then the marginal benefit of moving is reduced, while the marginal cost is not affected. This is true since $[p(i) - C_N]$ is reduced

by demand creation because the physician can attend more patients and no other terms are affected. Formally, differentiating (4), evaluated at f(i, 0), with respect to D under the above assumptions, yields $-N_i C_{NN} f_D r(i) < 0$.

In that particular case the physician will choose a lower i*, and demand creation is a sufficient condition to reduce physician's mobility for a given stock of physicians in the country. Otherwise, demand creation is neither a sufficient nor a necessary condition to demonstrate that physicians will locate in the central city areas.

By extension, one can show that the same result applies when the number of physicians increases. Finally, it is also possible to show that patient mobility has the same effect on demand in central city areas as demand creation, and it is a matter of empirical research to distinguish both effects on physicians' mobility. Let us now present our empirical analysis.

3. ECONOMETRIC MODEL AND EMPIRICAL FINDINGS

From the preceding theoretical discussion, many variables explain the probability that a given city will have at least one physician: population, average income, equilibrium price of services net of insurance, leisure, cost of moving and induced demand. Most of these variables are not directly observable but can be approximated.

Our data are for the Province of Quebec. Since it has been shown elsewhere that there is no empirical evidence to support the existence of an availability effect in Quebec (Contandriopoulos, Dionne, Tessier, 1983), we haven't considered induced demand in this part of the study. Moreover, price of services is fully covered by public insurance and is regulated at one uniform level across cities for the period analyzed (1977). Therefore its use would not yield any useful information. However, average income is still an important factor which serves to explain the demand for services even under full insurance (Hung and Phu, 1980). Population is directly observable. This completes the list of variables used to approximate the demand effects on the physicians' decision.

We have no direct information concerning hospital affiliation, leisure time and cost of moving. We have approximated the quality of leisure by the number of good restaurants in a particular area. Cost of moving was approximated by distance between central city areas and other cities, and this variable can also approximate the difficulties of being affiliated to a prestigious hospital when physicians work far from central city areas.

One interesting extension of the theoretical model would have been to introduce a production function permitting to consider the availability of inputs in cities with distance i. More particularly, it would have been interesting to consider the type of practices of specialists who move from central city areas to other cities. Our data does not permit us to consider this extension at this time. However, a dummy variable was used, indicating the presence or not of a hospital in the cities

considered, in order to control the environment and to have the appropriate interpretation of the other variables. Regions and the level of urbanization were also used as control variables.

3.1. Specification of estimation equations and dependent variables

Equations were estimated separately for all specialists, general practitioners and various specialists. The estimation of the model was made using both Probit and Logit techniques. Results were comparable, and only those obtained with the Probit procedure are presented here. In each regression, the dependent variable used is set to 1, if a particular town from amongst the 1, 198 in Quebec had at least one full-time physician (specialist or general practitioner depending upon the specific case) or otherwise set to zero. A full-time physician works at least 35 hours per week or declares an income greater than or equal to $37,500 ($9,338) a year for specialists who where certified before (in) 1977. For general practitioners the corresponding income levels were fixed respectively at $27,600 ($6,900). Data for these variables comes from the "Fichier de la corporation professionnelle des médecins du Québec", 1977.

3.2. Independent variables

A description of each variable is given below.

Population

This variable is used as in the NWBS' study. It reflects, in part, the total demand for medical services. Therefore, the probability of having at least one physician in a town is assumed to increase at a decreasing rate when the population increases. Data was taken from "Répertoire des municipalités", Bureau de la Statistique du Québec, 1976.

Average income

Since health services are not inferior goods (Newhouse and Phelps (1976), Hung and Phu (1980)), we predict a greater probability of there being at least one physician when average income increases, even under full insurance. Here income is a proxy for indirect costs associated with medical expenses (nursing costs, transportation, day care services,...). Data for 1977 comes from "Taxation Statistics", Revenu Canada, 1979.

Number of good restaurants

Cities were rated by the total of points (degree of excellence) earned by hotel restaurants opened all year round. This is a proxy for the quality of leisure (see Fuchs (1978) for a similar use of this type of variable). The theoretical model predicts a positive sign for this variable. Data was taken from "Hébergement Québec", Government of Quebec, 1982.

Distance

It is the distance in kilometers from the nearest city with at least one medical school in Quebec : Montreal, Quebec City and Sherbrooke. These cities are also major urban areas.

Distance is particularly important because it is one of the control variables in the theoretical model. Consequently, it contains information that is not explicitly contained in other variables. Furthermore, distance is a good approximation of moving costs for physicians and their families in terms of choice of city and accessibility to cultural areas, medical schools, university hospitals, etc...

From the theoretical model, we predict that the greater the distance of a particular city from either Montreal, Quebec City and Sherbrooke, the less the probability that a physician will come to this city. Moreover, we assume that the probability decreases at an increasing rate. This variable was constructed using information from "Distances routières", Gouvernement du Québec, 1979.

Hospitals

This variable is set to 1 if there is an hospital in the town, and to zero otherwise. As mentioned above, it is a control variable. Nevertheless, intuition suggests a positive sign for the coefficient of this variable. Data was obtained from Lemay (1985).

General practitioners per capita

This variable is used as an independent variable only in the equations which explain the probability that a town will have at least one specialist. It is defined as the number of full-time general practitioners in a given town, divided by the total population of the town. It also reflects information about medical resources and a positive sign is predicted for this variable.

Regions

We used regions that determine differential remuneration for physicians in Quebec since 1982. In a particular region, cities are considered homogeneous regarding the availability of medical resources which are not taken into account by other variables in the model. There are five regions and Region A is the omitted observation. Since it corresponds to cities having university hospitals, we predict negative signs for the coefficients of regions B, C, D, E. Data was taken from "Manuel des Omnipraticiens", Régie de l'Assurance-maladie du Québec, 1982.

Urbanization

This variable is an urbanization index of the various Quebec counties. It indicates the population living in towns with 10,000 or more inhabitants divided by the total population of the county. This variable is a complement to the population variable. We predict a negative sign since, when urbanization increases, it is easier for the residents to move to other towns of the same county in order to receive medical services. The variable was taken from Tessier, Contandriopoulos and Dionne (1985).

3.3. Empirical results

Tables 1 and 2 present the empirical results for all specialists and general practitioners respectively. In each table, the first column identifies the independent variables, the second column gives the mean values and standard deviations, the third column presents the estimated coefficients (t-ratios) and the last column presents the transformed coefficients for economic interpretation : it is the differentials of probabilities associated to each variable. For example, in Table 1, for a given municipality to be located in region B instead of region A, it reduces by 4.5% its probability of having at least one specialist. Table 3 shows similar results for various specialists. Only three variables are presented here but estimations contain other explanatory variables.

From Table 1, we observe that regions B and C, hospital, population variables, distance, average income, restaurants, and general practitioners per capita are all significant at a 95% level of confidence and have the signs predicted. In Table 2, only region E is not significant. All other coefficients are significant at a 95% level of confidence (except for coefficients of region D and average income which are significant at 90%). In Table 3, population, hospital and restaurants are also significant in explaining the probability for various specialists.

In Tables 1 and 2, population, restaurants, hospital, average income and number of general practitioners per capita (for specialists only) are variables which affect positively the probability that a given

city has at least one physician (specialist or general practitioner). On the other hand, distance from central city areas, regions B, C for specialists, regions B, C, D for general practitioners, and urbanization for general practitioners affect negatively the probability. Similar results are obtained for various specialists (see Table 3).

These results confirm the theoretical model. Indeed, factors related to demand (population, average income), to localization (distance, regions), and to quality of leisure (restaurant) explain the major part of the doctors' choices. Moreover, the results suggest that the standard location theory largely predicts the choices of physicians. However, other factors such as quality of leisure and availability of resources are also significant. More research is needed in order to isolate the detailed effects of these variables and to consider other factors such as prestige and induced demand when there is empirical evidence for it.

Table I

Probit analysis of location determinants for all specialists
(Quebec, 1977)

Explanatory Variables	Mean (Standard Deviation)	Estimated Coefficients (t ratio)	Transformed Coefficients
Constant		-3.998 (-4,33)	-0,9157
Region B	0,2705 (0,4444)	-0,343 (-1,81)	-0,0455
Region C	0,3831 (0,4864)	-0,387 (-1,68)	-0,0540
Region D	0,1619 (0,3685)	-0,050 (-0,11) *	-0,0076
Region E	0,0267 (0,1613)	-0,431 (-0,58)*	-0,0474
Hospital	0,0718 (0,2582)	1,282 (5,62)	0,3466
Population			
1- 530			0,0029
530- 907	5160,06	,000173	0,0024
907- 1470	(56624,96)	(7,86)	0,0043
1470- 2938			0,0162
2938-1879641			0,9635
Population^2			
1- 280900			0,0000
280900- 822649			0,0000
822649-2160900	3,23 X 10^9	-9,5 exp.-11	-0,0001
2160900-8621844	(10,22 X 10^{18})	(-7,82)	-0,0000
8621844-1 exp. 13			-0,1316
Distance			
1,0- 51,6			-0,0249
51,6- 86,8			-0,0157
86,8- 135,4	199,23	-0,00212	-0,0197
135,4- 308,9	(222,83)	(-1,63)**	-0,0511
308,9-1621,7			-0,0504

Table I (continued)

Probit analysis of location determinants for all specialists
(Quebec, 1977)

Explanatory Variables	Mean (Standard Deviation)	Estimated Coefficients (t ratio)	Transformed Coefficients
Distance^2			
1,0- 2662,6			0,0005
2662,5- 7539,2			0,0009
7539,2- 18333,1	89310,80	1,56 exp. -6	0,0021
18333,1- 95919,2	(216066,87)	(1,63)**	0,0166
95919,2-2629910,9			0,9139
Restaurants			
0- 5			0,1596
5- 10			0,2678
10- 30	0,0718	0,147	0,5004
30- 50	(0,2582)	(2,73)	0,0017
50- 89			0,0000
General practitioners			
0-.0001			0,0035
.0001-.0005	0,0003	259,279	0,0153
.0005-.0010	(0,0006)	(2,48)	0,0225
.0010-.0100			0,3147
Average income			
10657-11235			0,0112
11235-12094			0,0208
12094-12378			0,0081
12378-12913	12243,62	0,00019	0,0170
12913-16368	(1065,29)	(2,48)	0,1694
Urbanization			
0- 20			-0,0098
20- 40			-0,0090
40- 60	25,56	-0,0031	-0,0082
60- 80	(26,83)	(-0,97)*	-0,0075
80- 100			-0,0068

Likelihood ratio test = 452.752
Number of observations = 1198 : 142(1) 1056(0)

*Not significant at the 90% confidence level.
**Significant at the 90% confidence level.

All other coefficients are significant at the 95% confidence level.

Table II

Probit analysis of location determinants for general practitioners
(Quebec, 1977)

Explanatory Variables	Mean (Standard Deviation)	Estimated Coefficients (t ratio)	Transformed Coefficients
Constant		-1,633 (-2,42)	-0,3326
Region B	0,2705 (0,4444)	-0,773 (-4,89)	-0,2956
Region C	0,4307 (0,4954)	-0,328 (-2,19)	-0,1225
Region D	0,1619 (0,3685)	-0,386 (-1,45)**	-0,1488
Region E	0,0267 (0,1613)	0,372 (0,69)*	0,1272
Hospital	0,0718 (0,2582)	0,622104 (2,08)	0,2005
Population			
1- 530			0,0139
530- 907			0,0150
907- 1470	5160,06	0,000485	0,0327
1470- 2938	(56623,96)	(13,96)	0,1620
2938-1879641			0,7598
Population^2			
1- 280900			0,0000
280900- 822649			0,0000
822649-2160900	$3,23 \times 10^9$	-0,262 exp. -9	-0,0001
2160900-8621844	$(10,22 \times 10^{10})$	(-14,0)	-0,0003
8621844-1 exp. 13			-0,2521
Distance			
1,0- 51,6			-0,0136
51,6- 86,8	199,23	-0,00076	-0,0096
86,8- 135,4	(222,83)	(-1,66)	-0,0134
135,4- 308,9			-0,0495
308,9-1621,7			-0,3755

Table II (continued)

Probit analysis of location determinants for general practitioners

(Quebec, 1977)

Explanatory Variables	Mean (Standard Deviation)	Estimated Coefficients (t ratio)	Transformed Coefficients
Restaurants			
0- 5			0,3089
5- 10			0,0763
10- 30	0,0718	0,22254	0,0062
30- 50	(0,2582)	(2,89)	0,0000
50- 89			0,0000
Average income			
10647-11235			0,0166
11235-12094			0,0243
12094-12378	12243,62	0,00007	0,0079
12378-12913	(1065,29)	(1,31)**	0,0147
12913-16368			0,0884
Urbanization			
0- 20			-0,0422
20- 40			-0,0442
40- 60	25,56	-0,00588	-0,0457
60- 80	(26,83)	(-2,73)	-0,0466
80-100			-0,0469

Likelihood ratio test = 558,061
Number of observations = 1198 : 421 (1), 777 (0)

*Not significant at the 90% confidence level
**Significant at the 90% confidence level

All other coefficients are significant at the 95% confidence level.

Table III

Probit analysis of some location determinants for various specialists

(Québec, 1977)

Specialty	Population	Square of Population	Hospital	Restaurants (nb. of points)
Anesthesiology	$6,00 \times 10^{-5}$ (4,71)	$-3,4 \times 10^{-11}$ (-4,77)	1,048 (4,10)	0,136 (2,57)
General surgery	$7,60 \times 10^{-5}$ (5,46)	$-4,3 \times 10^{-11}$ (-5,84)	1,30 (6,03)	0,156 (2,91)
Orthopedic surgery	$3,10 \times 10^{-6}$ (0,57) *	$-5,8 \times 10^{-12}$ (-1,97)	1,37 (5,47)	0,194 (4,29)
Obstetrics/ Gynecology	$5,67 \times 10^{-5}$ (3,60)	$-3,4 \times 10^{-11}$ (-3,88)	1,89 (3,72)	0,206 (2,93)
Otolaryngology	$4,59 \times 10^{-7}$ (0,07) *	$-5,0 \times 10^{-12}$ (-1,32)*	2,262 (5.22)	0,233 (4,11)
Pediatrics	$8,57 \times 10^{-5}$ (5,17)	$-5,0 \times 10^{-11}$ (-5,22)	0,650 (1,91)	0,1328 (2,29)
Psychiatry	$3,70 \times 10^{-5}$ (3,41)	$-2,2 \times 10^{-11}$ (-3,65)	1,26 (5,11)	0,137 (2,69)
Radiology	$8,44 \times 10^{-5}$ (5,67)	$-5,0 \times 10^{-11}$ (-5,96)	0,917 (3,42)	0,152 (2,83)
Urology	$5,35 \times 10^{-5}$ (3,65)	$-3,0 \times 10^{-11}$ (-3,63)	1,15 (3,06)	0,100 (1,33)*
Primary care	$1,61 \times 10^{-4}$ (7,94)	$-8,8 \times 10^{-11}$ (-7,87)	1,148 (5,14)	0,158 (2,94)
Secondary care	$5,10 \times 10^{-5}$ (4,67)	$-3,0 \times 10^{-11}$ (-4,82)	1,080 (4,53)	0,140 (2,83)
Tertiary care	$5,99 \times 10^{-5}$ (4,07)	$-3,01 \times 10^{-11}$ (-3,86)	0,405 (1,25)*	$1,19 \times 10^{-2}$ (,15) *

t-ratios are in parentheses; *indicates that the coefficient is not statistically significant. Regressions also include as explanatory variables : regions variables; urbanization; average income; general practitioners; distance. Detailed results are available upon request.

4. CONCLUSION

In this paper we have presented a theoretical model which formalizes the physicians decision-making behavior with regard to geographical area of practice. We have shown that if the physicians maximize net income, cities around central city areas have a greater probability of receiving physicians. Moreover, when there are high costs of moving, all cities which have sufficient demand may not have physicians at the optimum, even if there is overcapacity in the country at large. This important conclusion was obtained without considering utility maximization and induced demand.

We have also shown that utility maximization and the consideration of arguments such as leisure and prestige have the same role as the cost of moving. However, there is no evidence that induced demand reduces the geographical dispersion of physicians.

The results of the empirical model are consistent with those of the theoretical model. They confirm the results of NWBS regarding the effect of both population and the regional location variables on the probability that at least one physician (specialist or general practitioner) is present in a town. They also show that leisure, distance from central cities areas, average income and hospital are significant to explain this probability for both specialists and general practitioners. Moreover, urbanization is significant for general practitioners and the presence of general practitioners in the city is significant for specialists.

Since 1982, the Government of Quebec uses an incentive monetary scheme in order to permit many cities away from central city areas to attract physicians : regulated fees for medical services in central city regions were reduced for new physicians, whereas they were increased in other regions (B, C, D, E in the empirical model). This price differential reflects market forces and will tend to reduce the variance of physicians distribution across regions as suggested by the results of Lindsay, Honda and Zycher (1978). However, as predicted by the model presented above, this type of policy is not necessarily sufficient to eliminate disparities in the short run. Other considerations have to be taken into account such as quality of leisure, hospital affiliation, moving cost..... Finally, since there is no evidence of market failure, one cannot conclude from standard economic theory, that the market forces are not able to give an optimal solution in the long run. Indeed, this study has shown that geographical inequalities in the distribution of physicians only reflect the high opportunity costs for physicians to move from major urban areas to rural centers.

REFERENCES

CONTANDRIOPOULOS, A.P., DIONNE, G., TESSIER, G., "Mobilité des patients et modèles de création de demande : le cas du Québec", Actualité économique, (décembre 1983), pp. 729-753.

DIONNE, G., CONTANDRIOPOULOS, A.P., "Doctors and their Workshops : A Review Article", Journal of Health Economics (March 1985) pp. 21-35.

EVANS, R., Price Formation in the Market for Physician Services in Canada 1957-1969, Prices and Incomes Commission, Ottawa, Queen's Printer, (1972).

FUCHS, V.R., "The Supply of Surgeons and the Demand for Operations", Journal of Human Resources, XIII, (Supplement, 1978), pp. 35-56.

HUNG, N.W., PHU, N.V., "Determinants de l'utilisation des services médicaux en régime d'assurance-maladie", Actualité économique, Vol. 56, (avril-juin 1980), pp. 164-194.

LEMAY, A., "Impact des ressources hospitalières sur le choix du lieu de pratique des médecins", Département de science économique, Université de Montréal, (1985).

LINDSAY, C.M., HONDA, S. and ZYCHER, B. (1978), Canadian National Health Insurance : Lessons for the United States, Roche Laboratoiries, New Jersey, 1978.

NEWHOUSE, J.P., PHELPS, C.E., "New Estimates of Price and Income Elasticities of Medical Care Services", in R.N. Rosett, The Role of Health Insurance in the Health Service Sector, N.B.E.R., New York, (1976).

NEWHOUSE, J.P., WILLIAMS, A.P., BENNETT, B.W. and SCHWARTZ, W.B., "Does the Geographical Distribution of Physicians Reflect Market Failure?", Bell Journal of Economics, Vol. 13, (Autumn 1982), pp. 493-506.

NEWHOUSE, J.P., WILLIAMS, A.P., BENNETT, B.W. and SCHWARTZ, W.B., "The Geographic Distribution of Physicians : Is the Conventional Wisdom Correct?", Rand Corporation R-2734-HJK/HHS/RWJ/RC, (October 1982), 50 p.

NEWHOUSE, J.P., WILLIAMS, A.P., BENNETT, B.W. and SCHWARTZ, W.B., "How Have Location Patterns of Physicians Affected the Availability of Medical Services?", Rand Corporation, R-2872/HJK/HHS/RWJ, (May 1982), 29 p.

PAULY, M.V., Doctors and their Workshops, University of Chicago Press, (1980).

REINHARDT, U., "Comment on Frank A. Sloan and Roger Feldman; Competion Among Physicians", in W. Greenberg, Ed., Competition in the Health Care Sector, Proceedings of a Conference Sponsored by the Bureau of Economics-Federal Trade Commission, Germantown, Md., Aspen Systems Corp., (1978).

SLOAN, F.A., FELDMAN, R., "Competition Among Physicians", in W. Greenberg, Ed., Competition in the Health Care Sector, Proceedings of a Conference Sponsored by the Bureau of Economics-Federal Trade Commission, Germantown, Md., Aspen Systems Corp., (1978).

TESSIER, G., CONTANDRIOPOULOS, A.P., DIONNE, G., "Patient Mobility for Elective Surgical Interventions", Social Science and Medicine, (1985), pp. 1307-1312.